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Operating Cost Behavior and Efficiency: A Preliminary Analysis[1]

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Abstract. This study explores the relation between operating cost behavior and operational efficiency for the manufacturing sector in Korea. We find that the operating costs indicate cost-stickiness on average for our pooled sample. However, empirical results for each individual year sample reveal that there exist substantial variations in terms of cost asymmetry. Furthermore, we observe anti-sticky cost behavior in 2007, 2009, and 2013 that is statistically significant. Additional graphical comparison between operating cost behavior and operational efficiency shows that there exists some negative correlation between the degree of cost aymmetry and the operational efficiency.

1 Introduction

Prior studies have predominantly explained cost asymmetry with economic factors such as resource intensity and uncertainty of future demand and have not considered the impact of operational efficiency on cost behavior. Drawing on the asymmetric cost behavior and the efficiency literatures (Banker and Byzalov 2014; Banker et al. 1984; Banker and Thrall 1992; Charnes et al. 1978), we address the following research question: Does there exist any relation between operating cost asymmetry and firm efficiency?

To estimate the behavior of operating costs which are defined as the sum of cost of goods sold and selling, general, and administrative costs, we use an empirical model suggested by Anderson et al. (2003). Operational efficiency is separately classified and measured as (i) aggregate efficiency (Charnes et al. 1978), (ii) technical efficiency (Banker et al. 1984), and (iii) scale efficiency (Banker and Thrall 1992). In this context, the objective of this study is to explore the relation between operating cost behavior and operational efficiency for the manufacturing sector in Korea. If the degree of operating cost stickiness is negatively associated with operational efficiency when sales decrease, we may conclude that operating cost stickiness plays a role in reducing operational efficiency.

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2 Research Design

Following Anderson et al. (2003), we estimate the following regression model (1) to replicate the operating cost asymmetry phenomenon documented in previous studies:

$$\Delta \ln COST_{i,t} = \alpha_0 + \alpha_1 \Delta \ln SALES_{i,t} + \alpha_2 SD_{i,t} \Delta \ln SALES_{i,t} + \varepsilon_{i,t} \quad (1)$$

where $\Delta lnCOST_{i,t}$ represents the log-change in operating costs for firm *i* in year *t*, $\Delta lnSALES_{i,t}$ is the log-change in sales revenue, the value of $SD_{i,t}$ is 1 when sales revenue decreases, and ε_{it} is an stochastic error term. The value of $SD_{i,t}$ is 0 when sales revenue increases, the coefficient α_1 measures the percentage increase in operating costs with a 1% increase in sales revenue.

This study applies data envelopment analysis (DEA) in estimating efficiency scores. We use the output-oriented three-input one-output model, the three inputs are (i) cost of goods sold, (ii) selling, general & administrative costs (SG&A costs), and (iii) the average balance of property, plant and equipment, and the output is sales revenue. First, we employ the output-oriented constant returns to scale DEA model of Charnes et al. (1978) to estimate the aggregate efficiency scores of the different observations. Second, we also employ the output-oriented variable returns to scale DEA model of Banker et al. (1984) to estimate the technical efficiency scores of the different observations. Third, we measure scale efficiency by dividing aggregate efficiency by technical efficiency (Banker and Thrall 1992).

3 Empirical Results

3.1 Data and Descriptive Statistics

The sample includes all manufacturing firms that are listed on the Korean Stock Exchange from 2003 to 2013. Furthermore, we impose the following additional criteria for our sample: (1) those firms whose fiscal years end on December 31 and (2) those firms whose financial data can be obtained from database TS2000. Table 1 provides descriptive statistics on output, inputs, and efficiency scores.

Table 1. Descriptive Statistics for Pooled Data (N=3,802)

Description		Mean	Std. Dev.	Q1	Median	Q3
Output	Sales Revenue	1,441,910	6,357,775	107,088	222,121	582,014
Inputs	Cost of Goods Sold	1,162,859	4,804,441	85,108	182,208	469,879
	SG&A Costs	169,206	985,306	10,669	22,387	68,032
	Plant, Property and Equipment	369,418	1,722,667	17,370	42,789	119,601
Efficiency	Aggregate Eff.	0.845	0.099	0.794	0.852	0.911
	Technical Eff.	0.879	0.096	0.825	0.888	0.95
	Scale Eff.	0.962	0.052	0.947	0.982	0.996

Note: Output and inputs are expressed in one million Korean won and deflated to 2010 Korean won using the index of consumer prices.

3.2 Estimation of Operating Cost Behavior

We present the results of estimating model (1) with changes in operating costs and sales revenue defined for each one-year period sample and for the pooled sample in Table 2.

Table 2. Results of Estimating Operating Cost Behavior

Year	Sample size	$\hat{\alpha}_1$		$\hat{\alpha}_2$		$\hat{\alpha}_1 + \hat{\alpha}_2$
		Estimate	t-value	Estimate.	t-value	
2003	283	0.792	11.89***	-0.153	-1.637*	0.639
2004	300	0.791	23.366***	-0.054	-0.723	0.737
2005	307	0.967	41.736***	-0.237	-6.358***	0.73
2006	320	1.041	34.654***	-0.236	-4.308***	0.805
2007	332	0.864	22.537***	0.111	2.736***	0.975
2008	346	1.323	38.188***	-0.586	-8.681***	0.737
2009	356	0.714	23.09***	0.081	1.661*	0.795
2010	371	0.810	24.733***	0.032	0.293	0.842
2011	379	0.941	31.128***	-0.157	-3.052***	0.784
2012	392	0.955	26.167***	-0.155	-3.368***	0.8
2013	406	0.751	26.28***	0.258	6.571***	1.009
Pooled	3,802	0.930	88.484***	-0.042	-2.807***	0.888

*, **, *** indicate statistical significance at 10%, 5%, 1% level, respectively.

For our pooled sample, the estimated value of $\hat{\alpha}_2$ provides strong support for the sticky cost behavior on average for the entire sample period. For our individual year sample, the absolute value of $\hat{\alpha}_2$ that represents the degree of cost asymmetry was the highest in 2008. Moreover, the estimated values of $\hat{\alpha}_2$ in 2007, 2009, 2010, and 2013 were 0.111, 0.081, 0.032, and 0.258, respectively. Thus we observe anti-sticky cost behavior in 2007, 2009, and 2013 that is statistically significant.

3.3 Efficiency Analysis

Table 3 reports each operational efficiency scores for each of 11 years from 2003 to 2013. The aggregate and technical efficiency indicates the highest scores in 2009, respectively, and the scale efficiency reveals the lowest score in 2005.

Table 3. Operational Efficiency Scores

Year	Sample size	Aggregate Efficiency	Technical Efficiency	Scale Efficiency.
2003	283	0.831	0.863	0.965
2004	300	0.833	0.865	0.965
2005	307	0.822	0.852	0.966

2006	320	0.816	0.849	0.963
2007	332	0.828	0.864	0.961
2008	346	0.805	0.856	0.958
2009	356	0.844	0.883	0.961
2010	371	0.843	0.878	0.962
2011	379	0.835	0.872	0.960
2012	392	0.823	0.857	0.962
2013	406	0.827	0.864	0.960
Average	3,802	0.828	0.864	0.962

3.4 Comparison of Operating Cost Behavior and Efficiency

Further graphical analysis in Figure 1 confirms that there exists some negative correlation between the absolute value of a2 (that is, the degree of cost aymmetry) and the operational efficiency scores. The higher the absolute value of a2, the lower the operational efficiency scores.

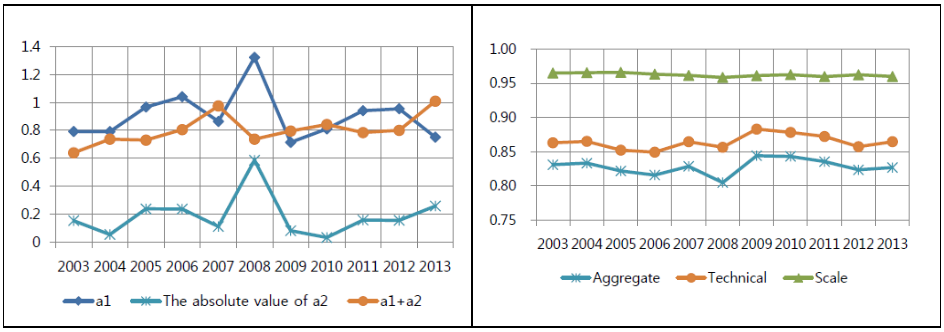

Fig. 1. Trends of Operating Costs Behavior and Efficiency Scores

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